**TQEM 1:**  **Digital Signal Processing (DSP)**

1. \_\_\_\_\_\_A Gaussian (normal) random variable X has the following probability

density function.



The mean value and variance of X are, respectively

A. (0, 8). B. (0, 2). C. (0, 4). D. (2, 4). E. (2, 8)

2. \_\_\_\_\_ Before sampling (digitizing) the signal from an accelerometer, the signal was

conditioned by passing it through a high-pass filter set at 1 Hz. The maximum frequency content of the signal is 5 kHz. The minimum frequency with which the signal must be sampled without errors in the digitized data is

1. 5 kHz B. 2.5 kHz C. 10 kHz. D. 2 Hz.

3. \_\_\_\_\_ If the rotating speed of a motor shaft is 1800 RPM, an imbalance in the shaft is

primarily seen in the bearing-mounted (vertical) accelerometer signal power spectrum at a frequency of

A. 30 Hz. B. 60 Hz. C. 900 Hz. D. 1800 Hz.

4. \_\_\_\_\_ Angular misalignment in a turbine-generator system is clearly indicated in

the frequency spectrum of an accelerometer signal at one times the rotating speed of the shaft, where the accelerometer is mounted on the bearing case in the

A. Angular direction. B. Horizontal direction.

C. Axial direction. D. Vertical direction.

E. (All with respect to the normal shaft axis)

5. \_\_\_\_\_ The rotational speed of a pump shaft is 19.5 Hz. The frequency spectrum of

accelerometers placed on inboard and outboard bearings in the vertical direction generally indicate parallel (offset) misalignment at a frequency of

A. 19.5 Hz. B. 39 Hz. C. 9.75 Hz. D. 29.25

6. \_\_\_\_\_ Monitoring of instrument channels serves the following purpose

A. Reliable process control action.

B. Application to instrument calibration reduction.

C. Timely decision-making by plant personnel for instrument maintenance.

D. All the above.

E. Only B & C.

7. \_\_\_\_\_ The oil whirl phenomenon in a sleeve bearing (journal bearing), with a shaft

frequency of 1.4 Hz, occurs approximately at the following frequency.

A. 1.4 Hz. B. 0.7 Hz. C. 2.1 Hz. D. 2.8 Hz.

8. \_\_\_\_The crest factor of a signal corresponding to a measurement X = 12 V, is equal to 4.

The root-mean-squared (RMS) value of the signal has a value of

A. 3 V2 B. 12/4 C. 4/12 D. (12 - 4) V E. (12 + 4) V

9. \_\_\_\_\_ A signal from an accelerometer mounted on a heat exchanger pump shaft

bearing was sampled 512 Hz. The maximum information frequency (Nyquist folding frequency) in the digitized signal is equal to

A. 1024 Hz. B. 512 Hz. C. 256 Hz. D. 128 Hz.

10. \_\_\_\_\_ The coherence function (in the frequency domain) between a pressure

transmitter signal and a flow meter signal is approximately equal to 1.0 in the range 0.01 Hz and 10 Hz. This indicates that

A. The two signals are linearly related in this frequency band

B. The signal-to-noise ratios of both signals are high in this frequency band

C. The signal-to-noise ratios of both signals are low in this frequency band

D. A and B

E. A and C

11. \_\_\_\_\_ An industrial fan has a rotational speed of 1200 RPM and has four blades. The

blade pass frequency at this speed is

A. 80 Hz. B. 60 Hz. C. 40 Hz. D. 20 Hz.

12.\_\_\_\_\_The frequency bandwidth of a high-quality piezo-electric accelerometer,

with stud mounting on the bearing housing has the range

A. Less than 100 Hz

B. Less than 1 kHz and is better than a hand-held accelerometer

C. Up to 20 kHz and is better than a hand-held accelerometer

D. Up to 20 kHz, but is not as good as a magnetically mounted accelerometer

13. \_\_\_\_\_ A three-phase induction motor signature analysis uses the following

measurements for condition monitoring

A. Wide-band motor current and voltages in all the three phases.

B. Wide-band motor current in only one phase.

C. Wide-band voltage in only one phase.

D. None of the above.

14. \_\_\_\_\_ The input electric synchronous frequency in an induction motor is 30 Hz and the

motor rotor speed is 29.5 Hz. The motor slip frequency is given by

1. 1.0 Hz. B. 0.5 Hz. C. 1.5 Hz. D. 59 Hz.

15. \_\_\_\_\_ If the maximum frequency content of a signal from an accelerometer is 3.0

kHz, what is the minimum frequency with which the signal must be digitized without creating errors in the digitized signal?

1. 1.5 kHz. B. 3 kHz. C. 4.5 kHz. D. 6 kHz.

16. \_\_\_\_\_ The data record acquired from instrumentation to measure the pressure in a

large pipe consists of 3500 sample points. What is the maximum number of points per block of data, so that there will be six blocks of data from the above sample points, to be processed using the fast Fourier transform (FFT) algorithm?

A. N = 550. B. N = 128. C. N = 256. D. N = 512.